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**EUROPEAN PATENT APPLICATION**

(21) Application number: 85308866.4

(51) Int. Cl.<sup>4</sup>: B 41 J 3/04

(22) Date of filing: 05.12.85

(30) Priority: 06.12.84 US 678907

(43) Date of publication of application:  
11.06.86 Bulletin 86/24

(84) Designated Contracting States:  
DE FR GB NL

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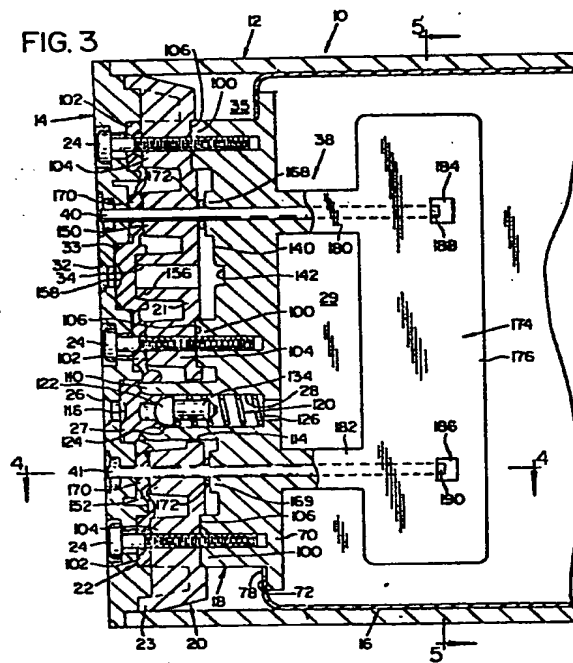
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(54) Ink cartridge manufacturing method and apparatus.

(57) An ink cartridge 10 is described with a rigid, hollow housing 12 within which an ink container assembly is positioned. The assembly includes an ink container 16 mounted, as by heat sealing, directly to an ink container support 18. The support 18 is secured by fasteners 24 to a cap 14 of the housing with a gasket 22 and gasket retainer 20 positioned between the support 18 and cap 14. The gasket retainer 20 includes plural gasket retaining projections 104, 150, 152, 156 and an outer peripheral wall 23 which bears against the cap 14 when the ink cartridge is assembled. The gasket support 20 and ink container support 18 cooperatively interfit. To manufacture the ink container assembly, the ink container support 18 is inserted through an opening 74 in a sheet of ink container forming material. The portions 78 of the ink container material bounding the opening are then secured to a planar mounting surface 72 of the ink container support 18. Sides 80, 82 of the sheet are then folded together and sealed to complete the ink container 16.

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FIG. 3



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## INK CARTRIDGE MANUFACTURING METHOD AND APPARATUS

Technical Field

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This invention relates to an ink cartridge and ink cartridge manufacturing method. More specifically, the ink cartridge is for an ink jet printer of the type which supplies pressurized fluid to the cartridge for  
15 pressurizing ink within the cartridge to enhance the flow of ink from the cartridge to an ink jet printing head.

Background of the Invention

20

Ink jet printers having one or more ink jet heads for projecting drops of ink onto paper or other printing medium to generate graphic images and text have become increasingly popular. To form color images,  
25 multiple ink jet printing heads are used, with each head being supplied with ink of a different color from an associated ink cartridge.

In a common arrangement, the print medium is attached to a rotating drum, with the ink jet heads  
30 being mounted on a travelling carriage that traverses the drum axially. As the heads scan spiral paths over the medium, ink from the ink cartridges is delivered to the ink jet heads. Ink drops developed within the heads are projected from a minute orifice to form an image on  
35 the medium. A suitable control system synchronizes the

generation of ink drops with the rotating drum.

Such printers commonly employ replaceable ink cartridges. One such known cartridge, designated the Maco cartridge, is produced by Matsushita Electronic Components Co., Ltd. of Japan. The Maco cartridge has an internal ink container which includes a collapsible ink bag and an ink bag support. The ink bag is an extruded tube of flexible Polyvinylchloride which is thermally sealed at one end. The ink bag support is inserted in the open end of the bag and clamped in place by a mechanical seal. More specifically, the portions of the ink bag which bound the ink bag opening are wedged between the sides of the ink bag support and a surrounding rubber ink bag sealing gasket. The assembled ink bag, ink bag support and ink bag gasket are inserted into an elongated metal clip of U-shaped cross section with a planar base and sides which overlies the sides of the ink bag sealing gasket. This assembly is positioned within a plastic housing. A cap portion of the housing compresses the clip and ink bag sealing gasket to complete the mechanical seal. Also, a cap gasket is provided between the base of the clip and the cap for sealing purposes. Furthermore, fasteners extend through the cap, the cap gasket, openings in the clip, and into corresponding bosses projecting toward the cap from the ink bag support to hold the assembled cartridge together.

The Maco cartridge ink bag support includes an annular projection which defines an ink flow passageway which communicates with the interior of the ink bag. This projection passes through the clip base, abuts one side of the cap sealing gasket, and is aligned with an ink flow port through the cap. When the cap gasket is punctured, ink may flow from the ink bag, through the ink flow passageway, the cap gasket and ink flow port and thereby from the cartridge to an ink jet head. In

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addition, an annular air flow passageway defining projection also extends from the ink bag support, through an opening in the clip base, and against the cap gasket. This air flow passageway is aligned with an air flow port through the cap. The air flow passageway has openings which communicate with the interior of the housing outside of the ink bag. When the cap gasket is punctured, air or other fluid under pressure may be delivered through the air flow passageway and into the housing, wherein it applies pressure to the ink bag. This urges ink from the ink bag through the ink flow passageway.

This Maco cartridge construction suffers from a number of disadvantages. For example, cartridges are used in environments where they are subject to being dropped or otherwise impacted. Prior cartridges, such as the Maco cartridge, tend to develop ink leaks when jarred in this manner. Leakage also is a problem when such known cartridges are subjected to substantial environmental temperature fluctuations. Also, leakage of the air pressure surrounding the ink bag is a problem when the cartridge housing is exposed to its own ink, both from the interior and exterior, especially at its solvent bondlines. The result is polycarbonate case cracking and attendant leakage.

In addition, prior cartridges, such as the Maco cartridge, are costly and difficult to manufacture and assemble. In particular, it is difficult to remove air and other gases from the Maco ink bag, by applying a vacuum to the ink flow passageway, before filling the ink bag with ink. It is important to remove such gases from the ink bag to prevent clogging of the ink jet print heads by the gas bubbles from the ink container.

Therefore, a need exists for an ink cartridge apparatus which overcomes these and other disadvantages of the prior art.

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Summary of the Invention

An ink cartridge in accordance with the present invention includes an ink container assembly which  
5 includes a flexible ink container mounted directly to an ink container support, as by thermally fusing the ink container to the support. An ink flow opening through the ink container support communicates with the interior of the ink container. A hollow durable housing receives  
10 and encloses the ink container assembly. Ink from the ink container passes through the ink container support and an ink flow port of the housing to the exterior of the housing for delivery to an ink jet head. The housing also includes a fluid flow port which communi-  
15 cates with the interior of the housing, but exteriorly of the ink container. When pressurized fluid, such as air, is fed through the fluid flow port to the interior of the housing, pressure is applied to the exterior of the ink container. This enhances the flow of ink from  
20 the ink container and cartridge.

As a more specific feature of the invention, the ink container support includes a planar ink container mounting surface along its perimeter. The ink container includes portions which define an opening for  
25 receiving the ink container support, such latter portions of the ink container abut the ink container mounting surface and are thermally fused thereto so as to seal the ink container support to the ink container.

As still another feature of the invention, the  
30 ink container assembly is formed by providing a sheet of ink container material with a central opening, positioning the ink container support within the opening, securing the ink container support to the ink container to seal the central opening, folding the sheet to form  
35 sides of the ink container, and securing the sides of the ink container together. In the illustrated preferred embodiment, the securing steps are accomplished

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by thermally fusing the elements together.

As a further featur of the invention, the ink container is formed f a multi-layered material with a first interior layer of a material which resists corrosion by ink in contact with such layer, a second layer  
5 of a vapor barrier material, and a third layer of an ink container reinforcing material.

As still another feature of the invention, the housing includes an elongated body portion and a cap.  
10 In addition, a gasket is positioned along the interior surface of the cap and a gasket support is provided between the gasket and the ink container support. The gasket support includes a peripheral wall which extends in a first direction and against the interior surface of  
15 the cap. In addition, gasket retaining projections also extend in the first direction and against the gasket to hold the gasket in place. Moreover, fasteners secure the cap, gasket, gasket support and ink container support together.

20 As a more specific feature of the invention, the gasket support includes a fluid passageway defining projection leading to the portion of the interior of the housing which is outside of the ink container. Upon delivery of pressurized fluid through this fluid  
25 passageway, pressure is applied to the ink container and enhances the flow of ink therefrom. Also, the gasket support has an opening through which an ink passageway defining projection of the ink container support extends into engagement with the gasket.

30 As still another specific feature of the invention, the gasket support and ink container support cooperatively interfit to strengthen and facilitate the assembly of the ink cartridge construction.

It is accordingly one object of the present  
35 invention to provide an improved ink cartridge and method of manufacturing such a cartridge, the cartridge being for an ink jet printer of the type which supplies

air or other pressurized fluid to the cartridge 0184456  
to enhance the flow of ink from the cartridge to an ink jet  
head of the ink jet printer.

It is another object of the invention to provide  
5 such an ink cartridge which resists the development  
of ink leaks due to shock and other impacts on the  
cartridge, due to environmental temperature fluctuations  
to which the cartridge is subjected, due to excessive  
fluid pressures within the cartridge, and due to  
10 exposure of internal and external portions of the  
cartridge housing to ink.

It is still another object of the invention to  
provide such an ink cartridge which is economical to  
manufacture and which utilizes a relatively small number  
15 of parts.

A further object of the invention is to provide  
such an ink cartridge which is easy to install in an ink  
jet printer, is easy to handle, and is easy to remove  
without spilling ink.

20 These and other objects, features and advantages  
of the present invention will become apparent with  
reference to the following description and drawings.

#### Brief Description of the Drawings

25

Fig. 1 is an isometric view of an ink cartridge  
in accordance with the present invention;

Fig. 2 is an isometric view of the underside of  
the ink cartridge of Fig. 1;

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Fig. 3 is a sectional view of the ink cartridge  
of Fig. 1, taken along lines 3-3 of Fig. 1;

Fig. 4 is a sectional view of the ink cartridge  
of Fig. 1, taken along lines 4-4 of Fig. 3;

35 Fig. 5 is a cross sectional view of a portion  
of the ink cartridge of Fig. 1, taken along lines 5-5 of  
Fig. 3;



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Fig. 6 is a partially broken away exploded view of the ink cartridge of Fig. 1;

Fig. 7 is a sectional view of a portion of the ink container; and

5        Fig. 8 is a plan view of a sheet of ink container forming material during an intermediate ink cartridge manufacturing step.

Detailed Description of Preferred Embodiment

10

With reference to Figs. 1, 2 and 6, an ink cartridge 10 in accordance with the invention, comprises an elongated hermetically sealed housing including a rectangular body 12 closed at one end by a cap 14. 15    Housed within the body is an ink container assembly comprised of an ink container 16 of a flexible, collapsible material which is mounted to an ink container support 18. The construction also includes a gasket support or retainer 20 between the ink container 20 support 18 and cap 14. Also, a cap sealing gasket 22 is provided between the cap 14 and gasket support 20 for purposes explained below. Fasteners 24 secure the ink container support 18 to the cap, with the gasket 25    retainer 20 has a base 21 and a peripheral wall 23 which projects from the base 21 and into engagement with the underside of the cap 14 when this assembly is fastened together. This fastened assembly is positioned within the housing body 12 and the cap 14 is secured, as by 30    adhesive, to the body 12 to seal the cartridge.

A path is provided for ink to flow from the interior of the ink container 16 to the exterior of the cartridge, from which the ink is delivered to an ink jet head of an ink jet printer. The cap 14 is provided with 35    an ink flow port 26 which communicates through an O-ring portion 27 of gasket 22, when O-ring 27 is punctured, and through an ink flow passageway 28, described below,

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with the interior 29 of the ink container 16. In addition, a path is provided for delivering air from the ink jet printer to the cartridge. The air applies pressure to the exterior of the ink container 16 so as to enhance the flow of ink from the cartridge. More specifically, the cap 14 includes an air flow port 32 which communicates through an O-ring portion 33 of gasket 22, when O-ring 33 is punctured, and through a pressurized air flow passageway 34, described below, with a portion 35 of the housing body 12 which is within the housing body and outside of the ink container 16. Typical operating pressures are approximately one pound per square inch. Because the housing is hermetically sealed, pressurized air is not lost from the housing. Also, ink does not leak from the housing in the unlikely event that the ink container 16 ruptures.

The cartridge also includes an ink level sensor, designated generally at 38, for determining the level of ink within the cartridge. Although described in detail below, the ink level sensor includes a pair of electrical probes 40, 41 extending from the interior of the ink container 16 to the exterior of the cartridge housing. These probes are of an electrically conductive material which resists corrosion by the ink, such as stainless steel. The ink jet printer applies an alternating current voltage across the probes at a location outside of the housing. In addition, the resistance in a conducting path through the ink between the probes is monitored. This resistance varies as ink is used from the ink container and the ink container collapses. The magnitude of the resistance provides an indication of the amount of ink within the ink cartridge. In particular, from this resistance, a determination is made of when the ink cartridge is low of ink and should be changed.

The housing body 12 is formed of a lightweight, durable, rigid, impact-resistant material. A poly-

carbonate material designated Lexan 141R-5107 and 0184456  
produced by General Electric Company. Because the cap  
14 is exposed to ink passing through the ink flow port  
27, it is desirable that this cap be formed of a  
5 material which resists corrosion when exposed to the  
ink. Polysulfone is one such suitable material.

Referring to Figs. 1 and 2, the body 12 is preferably molded and comprised of top and bottom plates  
40, 44, first and second side plates 46, 48 and an end  
10 plate 50. A handle 52 is formed by portions of the top  
plate 44 and side plates 46, 48 which extend beyond the  
end plate 50. Thus, handle 52 extends transversely  
between the two side plates and provides a convenient  
grip for use when removing and replacing the cartridge.  
15 The plate 44 includes a raised central portion 54, while  
keys 56 project upwardly from the plate 40. These keys  
and raised portion fit within a corresponding cartridge  
receiving socket of the ink jet printer and prevent  
inadvertent reversed installation of the cartridge.  
20 Guides 58 project from the sides 46, 48 of the housing  
12 and fit within slots in the cartridge socket to  
support and properly align the ink cartridge when  
installed.

The ink container assembly is best understood  
25 with reference to Figs. 3, 4 and 6. The ink container  
support 18 includes a support plate 70 with a flat  
planar ink container mounting surface 72 to which the  
ink container 16 is directly mounted and sealed. Although  
adhesive seals are suitable, in the preferred  
30 embodiment, this sealing is accomplished by thermally  
fusing the ink container to the mounting surface.

More specifically, in accordance with a preferred method of manufacturing the ink container  
assembly, a central opening 74 (Fig. 8) is provided in a  
35 rectangular sheet 76 of ink container forming material.  
The ink container support 18 is inserted upwardly  
through this opening 74 to position the marginal edge

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portions 78 of the sheet which bound the opening 74 against the mounting surface 72, as shown in Fig. 6. These edge portions are then thermally fused to the mounting surface. Thereafter, the ink container side forming portions 80, 82 of the sheet 76 are folded about the longitudinal axis of the ink container support plate 70, that is, along fold line 83 in Fig. 8, until positioned as shown in Fig. 6. The sides 80, 82 are then sealed together along edges 84, as by heat sealing, to complete the ink container assembly.

In the preferred embodiment, the ink container support 18 is formed of a material which resists corrosion by the ink, with polyethylene being one suitable material. Furthermore, the ink container 16, see Fig. 7, is formed of a sheet 76 of multi-layered construction. The inner most layer 90 is comprised of a material which is compatible with the ink. That is, it resists corrosion by the ink. Also, this material is suitable for heat sealing. This first layer may comprise a low density polyethylene. The central layer 92 of sheet 76 provides a vapor barrier which minimizes the passage of gas into the ink container 16. Gas in the ink may form minute bubbles which clog the ink jet head of the printer. One suitable vapor barrier is a sandwich of a layer of polyvinylacetate between two layers of polyvinylidene chloride. This latter material is commonly designated by the trademark SARAN. Finally, the outer layer 93 is an ink container reinforcing material, which adds strength and some stiffness to the ink container. One suitable example is sixty gauge bi-axial nylon. A multi-layered material which fits this description is presently being sold by Champion International Corporation of San Leandro, California for applications such as containing wine within cardboard cartons.

The stiffness of the outer layer facilitates the collapsing of the bag in a predictable manner. This

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factor improves the performance of the ink level sensor 38, as explained below. Moreover, with this construction, and due to the relatively greater stiffness of applicants container when compared to the known prior art, applicant is able to easily remove all gas from the ink container prior to filling the container with ink. This is accomplished by applying a vacuum to the ink flow port 32, which fully collapses the ink container and removes gas from the container.

10           With reference again to Figs. 2, 4 and 6, plural fastener receiving bosses 100 project in a first direction toward cap 14 from the surface of the ink container support plate 70. Each of the fasteners 24 pass through an opening in the cap, an O-ring portion 15 102 of the gasket 22, a projection or boss 104 extending in the first direction from the base 21 of the gasket retainer 20, and is threaded into the fastener receiving bosses 100. As shown in Fig. 2, the ink container support 18 interfits the gasket retainer 20 so as to 20 strengthen the construction. More specifically, the bosses 100 mate within corresponding recesses 106 which are provided in the gasket retainer base 21. Thus, when the cartridge is assembled, the ink container support is held securely in place.

25           An annular ink flow passageway defining projection 110 also extends in the first direction toward cap 14 from the plate 70. The ink flow passageway 28 extends through projection 110. When the cartridge is assembled, ink flow projection 110 passes through an 30 opening 114 through the base 21 of the gasket retainer 20. This projection 110 abuts the interior surface of the gasket O-ring portion 27. The opposite surface of the O-ring portion 27 surrounds and seals the ink flow port 26. The center 116 of the O-ring portion 27 is 35 initially sealed as indicated in Fig. 3. When this seal is punctured, ink is permitted to flow from the ink container 16, through the ink flow passageway 28,

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through the gasket port 27 and out of the ink flow  
port 26. A check valve assembly 120 is provided within  
the passageway 78. The assembly 120 includes a valve  
having a hemispherical head 122. The head 122 is urged  
5 against a valve seat 124 of the O-ring portion 27 by a  
coil spring 126 positioned within the ink flow passage-  
way. The valve has a stem 134 which extends loosely  
within the center of the coil spring so that the valve  
is retained in place without the need for adhesive. The  
10 valve and spring are preferably of an ink corrosion  
resistant material, such as respectively of polyethylene  
and stainless steel.

A reinforcing rib 140 extends between the  
various projections of the ink container support. This  
15 rib has a notch 142 which is positioned in alignment  
with the pressure fluid port 32 when the cartridge is  
assembled. The notch 42 provides an enlarged  
unobstructed opening and clearance for insertion of an  
air supply needle into the interior 35 of the housing  
20 12.

Various gasket retaining projections extend in  
the first direction toward the cap 14 from the base 21  
of the gasket retainer 20. As previously mentioned,  
these gasket retaining projections include the bosses  
25 104. In addition, these projections include annular  
projections 150, 152 through which the respective probes  
40, 41 are inserted when the cartridge is assembled. In  
addition, an annular pressure air flow projection 156  
extends in this first direction from the base 21 of the  
30 gasket retainer 20. The air flow passageway 34 passes  
through the projection 156. The air flow projection  
extends into engagement with the interior surface of the  
O-ring portion 33 of the gasket 22. The other surface  
of O-ring portion 33 is positioned against the cap 14  
35 and surrounds and seals the air flow port 32. The  
center 158 of O-ring portion 33 is initially sealed to  
block the flow of air through port 32 until the gasket

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is punctured. As can be seen from Fig. 3, upon puncturing the O-ring portion 33 at 158, pressurized air may be delivered through the flow port 32, through the gasket O-ring portion 33, through the passageway 34, and past the notch 142 and into the interior 35 of the housing 12. Reinforcing ribs provide added support to the various projections from the gasket retainer. Thus, when assembled, the gasket 22 is held by the projections of the gasket retainer 20 against the cap 14.

Appropriate recesses, unnumbered, are provided in the interior surface of the cap 14 for receiving the gasket 22.

The probes 40, 41 are preferably molded into the ink container support 18 during the manufacture of this support. Projections 168, 169 extend toward the cap 14 from the ink container plate 70 and surround and reinforce the respective probes 40, 41 at the location where the probes emerge from the plate 70. Probe 40 extends from the projection 168, through projection 150 of the gasket retainer 20, through an O-ring portion 170 of the gasket 22 and through an opening in cap 14 to the exterior of the cartridge. Similarly, probe 41 extends from projection 169, through projection 152 of the gasket retainer 20, through a corresponding O-ring portion 170 of the gasket 22 and through another opening in cap 14 to the exterior of the cartridge. Also, O-rings 172 surround and seal the probes 40, 41 at a location between projections 168, 169 and the base 21 of the gasket retainer 20. Thus, the probes 40, 41 are supported securely and are easily accessible for application of a voltage across the ends of the probes which are exposed to the exterior of the cartridge.

The gaskets 22 and 172 are typically of an ink corrosion resistant material of suitable resiliency, such as rubber. Ethylenepropylene of 50 durometer on the Shore A scale is one suitable gasket material.

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Also, the gasket support 20 may be of the same material as housing 12.

With this construction, the ink cartridge 10 is extremely resistant to ink leakage arising from impact to the cartridge, environmental temperature fluctuations, above normal pressure within the ink cartridge, and due to exposure of internal and external portions of the cartridge housing to ink. Moreover, the ink cartridge is easy to manufacture, install and use.

The ink level sensor 38 and its operation will be described with reference to Figs. 3, 4 and 5. The ink level sensor 38 includes a probe supporting structure 174 projecting from the ink container support plate 70 into the interior of the ink container 16. A portion of the probes, in this case the probe tips 188, 190 are exposed by the supporting structure to ink within the interior of the ink container 16. The ink being conductive, upon application of a voltage across the probes, the resistance of conductive path through the ink and between the two probes may be monitored by the ink jet printer. As ink is used, the ink container 16 collapses as shown in dashed lines in Figs. 4 and 5. Eventually, the path between the two probes through the ink is completely blocked by the collapsed ink container 16. When this occurs, the monitored resistance jumps to a high level. This change in resistance provides an indication that the ink cartridge 16 is low of ink and should be replaced.

More specifically, the probe supporting structure 174 may comprise a platform 174 supported by necks 180, 182 which project from the ink container support plate 70. The probes 40, 41 extend through the respective necks and into the interior of the platform 174. As can be seen in Fig. 4, these necks are tapered moving away from the ink container support plate 70. This tapering guides the container 16 as it collapses to facilitate the container in a controlled uniform manner.



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Apertures 184, 186 are provided through the platform 174 with the tips 188, 190 of the probes extending into these apertures. Thus, the exposed portions of the probes are completely surrounded by the platform 174. As the ink is used, the ink container 16 collapses against upper and lower flat planar ink container closure surfaces 176, 178 of platform 174. This closes off the conductive path between the two probes. Furthermore, this ink container collapses against surfaces 176, 178 when consistently the same amount of ink remains in the ink cartridge.

Moreover, as can be seen in Fig. 5, the probes are sized so as not to project into the planes of the upper and lower surfaces 176, 178 of the platform. Therefore, the probes themselves do not interfere with the closing of the ink container against the closure surfaces. Thus, a flat closure surface is provided between the exposed regions of the probe. Only one such flat surface would be provided in the event the probes are only exposed to ink through one surface of the probe supporting structure.

Therefore, by monitoring the resistance, a precise determination can be made of the amount of ink in the cartridge. Furthermore, the cartridges may be changed before they run dry of ink, which could cause a bubble to form in the ink jet head and clog the head. For example, for a 200 milliliter volume cartridge, it is desirable to change the cartridge when no less than 20 milliliters of ink remain. Also, changing of the cartridges is not performed too soon, which would waste significant amounts of ink in the cartridge. The ink jet printer is provided with a shut off circuit which automatically stops the printer when a cartridge is low of ink, as indicated by the resistance measured across the probes. After the cartridge is replaced, the printer is then restarted.

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Having illustrated and described the principles  
of my invention with respect to one preferred embodiment,  
it should be apparent to those persons skilled in  
the art that such invention may be modified in arrangement  
and detail without departing from such principles.  
5 I claim as my invention all such modifications as come  
within the true spirit and scope of the following claims.

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CLAIMS

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1. An ink cartridge for an ink jet printing apparatus of the type which supplies pressurized fluid to the cartridge for pressurizing ink within the cartridge to enhance the flow of ink from the cartridge to an ink jet printing head of the ink jet printing apparatus, the ink cartridge comprising:

an ink container assembly including a collapsible ink container with an ink container support receiving opening, and an ink container support means connected to the portion of the ink container which defines the support receiving opening so as to seal the ink container support means to the ink container, the ink container support means having an ink flow opening therethrough which communicates with the interior of the ink container;

a hollow housing which receives the ink container assembly, the housing including an ink flow port, through which ink passing from the ink container and through the ink flow opening is delivered to the exterior of the housing, the housing also including a fluid flow port communicating with the interior of the housing and exteriorly of the ink container, whereby upon supplying pressurized fluid through the fluid flow port to the interior of the housing, pressure is applied to the exterior of the ink container to enhance the flow of ink through the ink flow opening and ink flow port.

2. An ink cartridge according to claim 1 in which the portion of the ink container which defines the support receiving opening is thermally fused to the ink container support means to seal the ink container support means to the ink container.

3. An ink cartridge according to claim 2 in which the ink container support means comprises a support plate with an ink container mounting surface along the perimeter of the support plate, the portion of the

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ink container which define the support receiving pening  
abutting the ink container mounting surface and being  
thermally fused to the ink container mounting surface so  
as to seal the ink container support means to the ink  
5 container.

4. An ink cartridge according to claim 3 in  
which the ink container mounting surface is planar.

5. An ink cartridge according to claim 1 in  
which the ink container is comprised of a first interior  
10 layer of a material which resists corrosion by ink in  
contact with the first interior layer, a second layer of  
a vapor barrier material, and a third layer of a con-  
tainer reinforcing material.

6. An ink cartridge according to claim 5 in  
15 which the second layer is intermediate the first  
interior and third layers, the first interior layer com-  
prising polyethylene, the second layer comprising a film  
of polyvinylacetate sandwiched between first and second  
films of polyvinylidenechloride, and the third layer  
20 comprising a biaxial nylon layer.

7. An ink cartridge according to claim 1 in  
which the housing comprises an elongated body having an  
ink container assembly receiving opening through which  
the ink container assembly is inserted into the body,  
25 the housing also including cap means mounted to the body  
for closing and sealing the ink container assembly  
receiving opening, the ink flow and fluid flow ports  
being provided through the cap means;

gasket support means positioned intermediate  
30 the cap means and the ink container support means, the  
gasket support means including a base with first and  
second side surfaces, the second side surface being  
positioned adjacent to the ink container support means,  
the gasket support means having a wall projecting from  
35 the perimeter of the first surface of the base in a  
first direction and into engagement with the interior  
surface of the cap means, the gasket support means also

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having plural gasket retaining projections extending in the first direction from the base;

fluid flow passageway means for providing a fluid flow passageway from the fluid flow port to the interior portion of the housing which is outside the ink container;

ink flow passageway means for providing an ink flow passageway from the ink flow port to the ink flow opening;

gasket means positioned intermediate the cap means and the gasket support means, said gasket means abutting and being supported in position by the gasket retaining projections, the gasket means comprising means for sealing the fluid flow and ink flow passageways, said gasket means also including puncturable seal means for selectively blocking the ink flow and fluid flow passageways until such puncturable seal means is punctured; and

fastener means for mounting the ink container support means to the cap means with the gasket means and gasket support means positioned between the cap means and the ink container support means.

8. An ink cartridge according to claim 7 in which a first of said gasket retaining projections comprises the fluid flow passageway means, the fluid flow passageway being provided through the first projection.

9. An ink cartridge according to claim 8 in which said base includes an aperture therethrough in alignment with the ink flow port, the ink flow passageway means comprising an ink flow projection extending in the first direction from the ink container support means and passing through the aperture, the ink flow passageway being provided through the ink flow projection.

10. An ink cartridge for an ink jet printing apparatus of the type which supplies pressurized fluid to the cartridge for pressurizing ink within the cartridge to enhance the flow of ink from the cartridge to

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an ink jet printing head of the ink jet printing apparatus, the ink cartridge comprising:

an ink container assembly including a flexible ink container with an ink container support receiving opening, and an ink container support means connected to the portion of the ink container which defines the support receiving opening so as to seal the ink container support means to the ink container, the ink container support means having an ink flow opening therethrough which communicates with the interior of the ink container, the ink container support means comprising a support plate with a planer ink container mounting surface along the perimeter of the support plate, the portion of the ink container which defines the support receiving opening abutting the ink container mounting surface and being thermally fused to the ink container mounting surface so as to seal the ink container to the ink container support means;

a hollow housing which receives the ink container assembly, the housing including an ink flow port through which ink passing from the ink container and through the ink flow opening is delivered to the exterior of the housing, the housing also including a fluid flow port communicating with the portion of the interior of the housing which is outside of the ink container, whereby upon supplying pressurized fluid through the fluid flow port to the interior of the housing, pressure is applied to the exterior of the ink container to enhance the flow of ink through the ink flow opening and ink flow port, the housing comprising an elongated body having an ink container assembly receiving opening through which the ink container assembly is inserted into the body, the housing also including cap means mounted to the body for closing and sealing the ink container assembly receiving opening, the ink flow and fluid flow ports being provided through the cap means;

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gasket support means positioned intermediate the cap means and the ink container support means, the gasket support means including a base with first and second side surfaces, the second side surface being positioned adjacent to the ink container support means, the gasket support means having a wall projecting from the perimeter of the first surface of the base in a first direction and into engagement with the interior surface of the cap means, the gasket support means also having plural gasket retaining projections extending in the first direction from the base, a first of said gasket retaining projections defining a fluid flow passageway therethrough which communicates from the fluid flow port through the base of the gasket support means to the region between the ink container and body of the housing;

the base of the gasket support means also including an aperture therethrough in alignment with the ink flow port, the support plate including an ink flow projection extending in the first direction from the support plate and passing through the aperture, the ink flow projection defining an ink flow passageway for the passage of ink therethrough from the ink flow port to the ink flow opening;

valve means in the ink flow passageway for selectively blocking the flow of ink from the ink container and ink flow opening through the ink flow port;

gasket means positioned intermediate the cap means and the gasket support means, said gasket means abutting and being supported in position by the gasket retaining projections and by the ink flow projection, the gasket means comprising means for sealing the fluid flow and ink flow passageways, said gasket means also including puncturable seal means for selectively blocking the ink flow and ink flow passageways until such puncturable seal means is punctured; and

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fastener means for mounting the ink container support means to the cap means with the gasket means and gasket support means positioned between the cap means and the ink container support means.

5 11. An ink cartridge according to claim 10 including means for cooperatively interfitting the ink container support means to the second surface of the base of the gasket support means.

10 12. An ink cartridge according to claim 11 in which said means for cooperatively interfitting comprises recesses defined by the second surface of the base, the ink container support means including projections extending in the first direction from the plate which are sized for insertion into the recesses to  
15 thereby cooperatively interfit the ink container support means and gasket support means.

13. A method of manufacturing an ink cartridge for an ink jet printing apparatus of the type which supplies pressurized fluid to the cartridge for pressurizing ink within the cartridge to enhance the flow of  
20 ink from the cartridge to an ink jet printing head of the ink jet printing apparatus, the method comprising:

providing a central ink container support receiving opening in a sheet of flexible ink container  
25 forming material;

positioning an ink container support within the ink container support receiving opening, the support having an ink flow opening therethrough, connecting the portions of the sheet which bound the ink container  
30 support receiving opening to the ink container support so as to seal such portions to the ink container support;

folding the sheet of ink container forming material about the ink container support to form first and second sides of an ink container; and

35 fastening the edges of the first and second sides together to form an ink container, the interior of



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the ink container communicating with the exterior thereof through the ink flow opening;

enclosing the assembled ink container and ink container support in a housing which has an ink flow port in communication with the ink flow opening, the housing also having a fluid flow port in communication with the interior of the housing and exteriorly of the ink container, whereby pressurized fluid entering the fluid flow port applies pressure to the ink container and enhances the flow of ink from the ink container and ink flow opening to the ink flow port.

14. A method of manufacturing an ink cartridge according to claim 13 in which the step of connecting the portions of the sheet to the ink container support comprises the step of thermally fusing the portions of the sheet which bound the ink container support receiving opening to the ink container support, and in which the step of fastening the side edges of the first and second sides together comprises thermally fusing the first and second sides together along their edges to form the ink container.

15. A method of manufacturing an ink cartridge according to claim 14 including the step of applying a vacuum to the ink flow port to withdraw gases from the ink container and following the removal of such gases, filling the ink container with ink.

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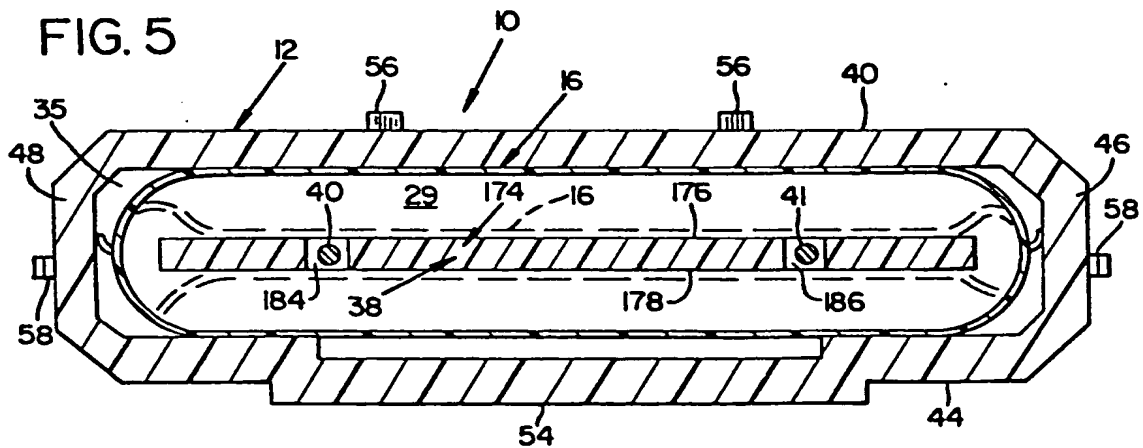
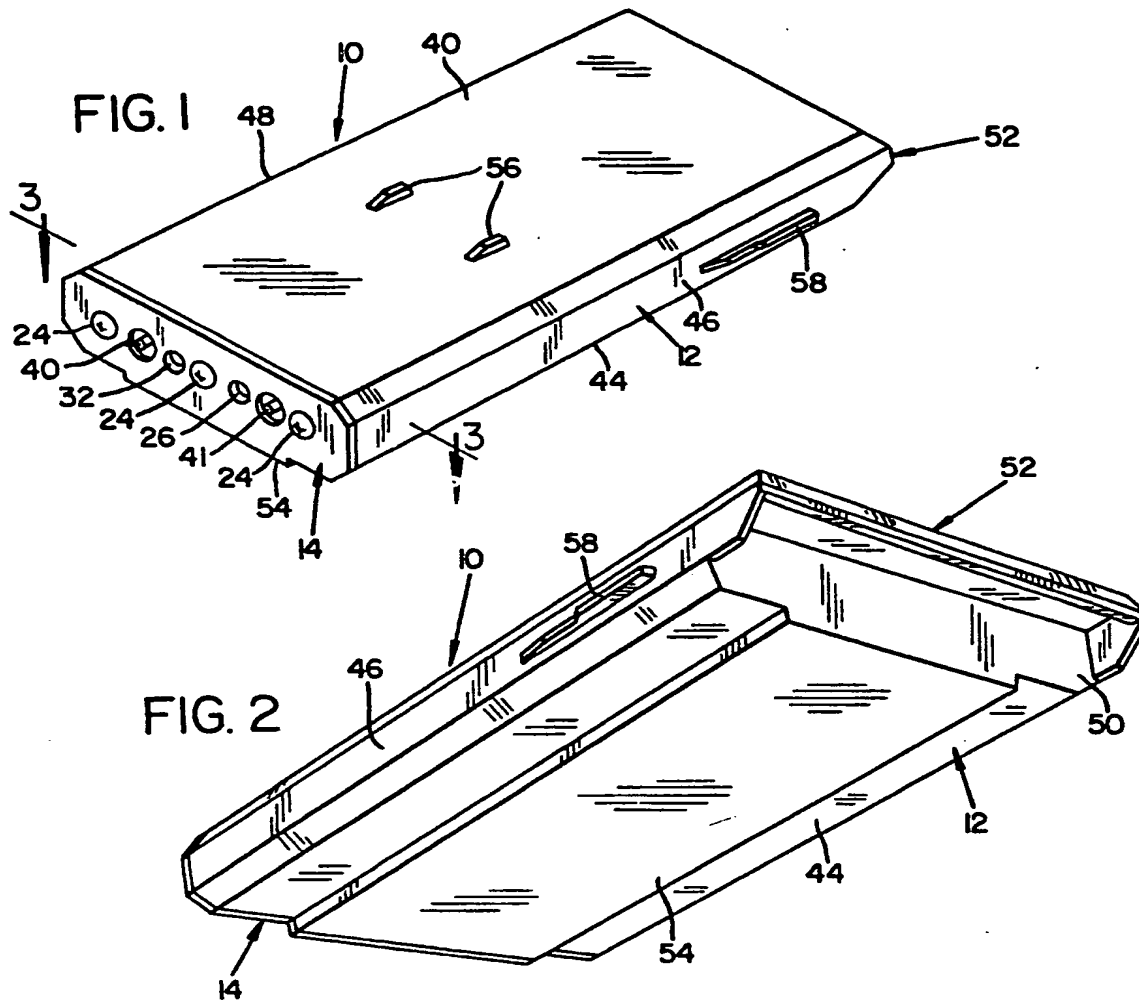


FIG. 3

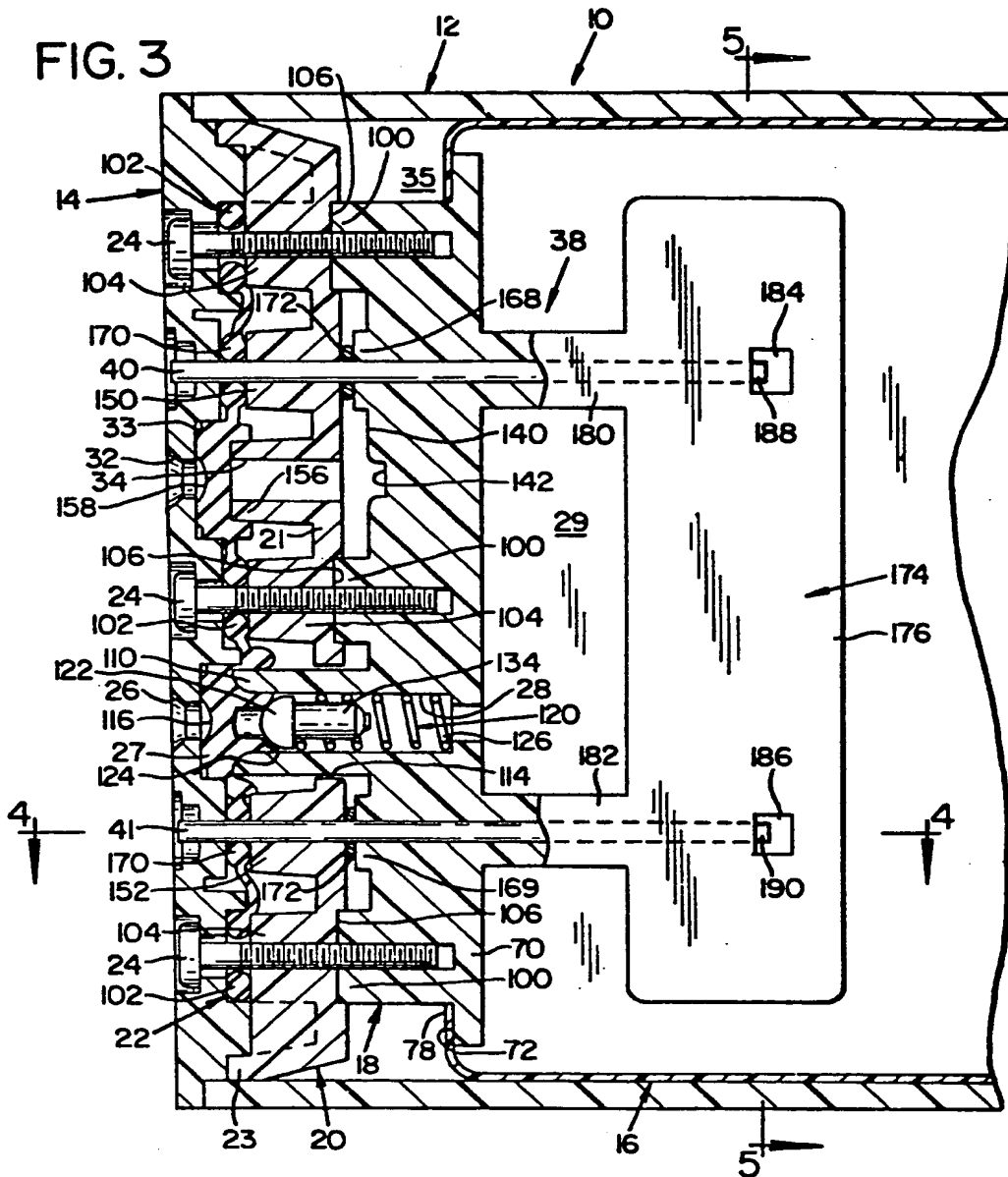


FIG. 4

